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RESEARCH MEMORANDUM

BUDGETING THE NON-PROFIT ORGANIZATION
AN AGENCY THEORETIC APPROACH

Alfons J. Daems

FEW 451

Budgeting the Non-profit Organization
An Agency Theoretic Approach

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Preliminary version**

Abstract

This paper studies the relation between the government and the non-profit organization from an agency theoretic perspective. Contracting out the production to the non-profit organization, makes it necessary to the government to provide incentives for the non-profit organization to make choices which will maximize the government's utility. The agency theory stresses the role of the budget structure in the relation between these two parties. The consequences of different forms of budgeting to the maximization process of the government are both described and modelled. The latter is done by postulating an utility function for the government. The optimization of this utility function, subject to the utility function of the bureaucrats of the non-profit organization, will be studied both for the case in which the government has perfect foresight, as well as the case in which the government has imperfect foresight.

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1. Introduction

In some situations, the government intervenes in the market process by partially or fully financing the production process. The primary goal of this intervention is to attain a socially more acceptable equilibrium of supply and demand. This paper tries to solve the problem of optimal financing by the government of the particular non-profit organizations involved in this government activity. Based on an agency-theoretic approach, the different forms in which the production can be financed are compared. In section 2, the theory of "Welfare Economics" is enunciated which results in a social welfare function, as formulated in section 3. Economic models of behaviour are presented in section 4. The models of Niskanen, Williamson and of Mique & Belanger imply an utility function of the bureaucrats of the non-profit organization. Section 5 reflects the agency theory, which stresses the importance of the role of budgeting in the relation government vs. non-profit organization. The consequences of different forms of budgeting to the maximization process of the government are described in section 6 and 7. In section 6, the government is assumed to have perfect information at the cost function of the non-profit organization as well as on the utility function of the bureaucrats, whereas in section 7 the government is assumed to be confronted with uncertainty with respect to these functions. The presentation of the model which represents these theories and tries to optimize the utility function of the government is made in section 8, whereas the results of uncertainty to the decision making process are studied in section 9. Finally, the conclusions are presented in the section 10.

2. Welfare Economics

The theories that are concerned with microeconomic analysis of govermental intervention in the market process and relevant to this study, are the "Theory of Public Finance" and the "Theory of Welfare Economics". The "Theory of Public Finance" examines simultaneously the optimal size and composition of the public funds. As this theory uses the concept of social welfare, this "concept" has to be defined. Analyses concerning this problem relate to the theory of "Welfare Economics". This theory contains three well-known views on the problem of social welfare:

1 *Theory of Pigou*

In Pigou's analysis, the social welfare is equal to the sum of individual utilities:

$$W = u_1 + u_2 + ... + u_{n-1} + u_n \qquad (1)$$

with: W = Social Welfare

u^i = Utility of individual i

n = Number of individuals

Pigou's work is based on the conceptions that individual utility is measurable and that an intersubjective comparison of these individual utilities is possible. The ordinality of utility and the impossibilty of the interpersonal comparison of these utility measurements are serious drawbacks of this approach. Therefore, other alternatives were developped.

2 *Theory of Pareto*

In Pareto's view, an allocation X is Pareto efficient if there is no feasible allocation X' such that all agents prefer X' to X. An alternative formulation of Pareto efficiency is: "There is no feasible allocation where everyone is at least as well off, and at least one agent is strictly better off". Social welfare is no longer equal to the sum of individual utilities, but is a more general function of the welfare of the individual subjects:

$$W = f(u_1, u_2, ..., u_{n-1}, u_n) \qquad (2)$$

A well-known disadvantage of the Pareto criterium is the impossibility of making a trade-off between efficiency and equity. Pareto efficient outcomes excludes departures from distributional equity. Therefore, the problem is that this approach generates a lot of Pareto optima in stead of one.

3 *Theory of Bergson*

In contrast to the concept of the Pigovian and the Paretian social welfare functions, which are based on the individual utility functions, the theory of Bergson makes use of a collective subject (usually the government) with a collective social welfare function. Elements like external effects are incorperated in Bergson's welfare functions. Usually, it is hard to specify this function.

In this paper, we study the relation between the government and a single non-profit organization. We are more interested in the process of attaining the social welfare optimum then in the exact determination of this optimum. Therefore, it seems reasonable to choose the theory of Bergson which is the most suited for this approach. Thus, an utility funtion of the goverment will be defined.

3. Utility function of the Government

3.1. Introduction

Before defining the government's utility function, it is necessary to stress the limitations of this study. First of all, we examine the relation between government and non-profit organization in a microeconomic context. Macroeconomic aspects like inflation and unemployment are left out. Secondly, the relation will be restricted to the government vs. ***one*** non-profit organization (e.g. a hospital) in one sector of the non-profit economy (for example "Health Care"). Competition between non-profit organizations is therefore impossible. Thirdly, both government and non-profit organization are not organizations with multiple individuals with their own objectives, but they will act as one person with one overall objective. And last but not least, the government has perfect foresight. Later however, this last assumption will be released.

3.2. Modelling Government's Behaviour

In order to determine an utility function of the government, we assume that the government ***behaves*** as follows. Firstly, the government assesses her total tax income (public funds), which she allocates to the several departments. We assume that these departments are ***"expense centers"***, which have as their main objective to maximize their specific goal ***without exceeding*** their total budget.

In order to model this, we assume that a department produces two goods, x_1 en x_2, which both are arguments of a concave utility function. Now it is possible to construct the indifference curves of $[x_1, x_2]$ each of which, as is well-known, represent all combinations of the goods with the same utility. In the same way, we can determine the total cost of each combination of both goods. Analogous to the determination of the iso-utility-curves, we can derive iso-costs-curves, each of which represent the combinations $[x_1, x_2]$ with the same total costs to the government[1]. Figure 1 shows the indifference curves, each of which have a point of tangency with the corresponding iso-costs-curves.

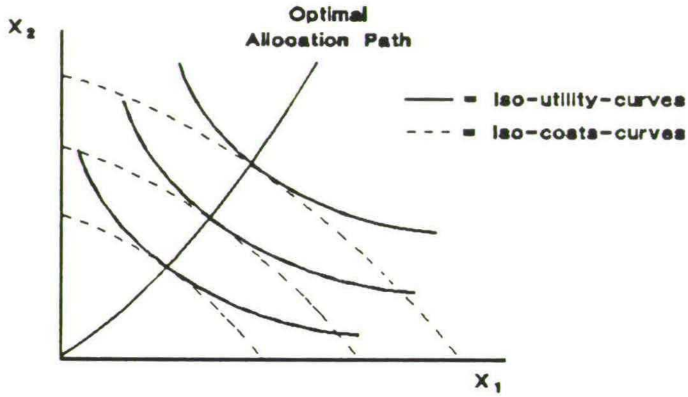

Figure 1: Determination of the optimal allocation path

These points of tangency are optimal to the government, in the sense that each point gives the government the highest utility given some cost-level, or, the other way round, the lowest cost given a certain level of utility. By connecting these points of tangency, we get a path which represents the set of all possible efficient allocations by the government. Figure 1 shows this path, which is called the "optimal allocation path". Given the budget volume of the department, it is easy to determine the optimal mix $[x_1, x_2]$. But if we compare this strategy with the functioning of the market mechanism, this strategy is suboptimal because "marginal cost" and "marginal profits" are not weight one against another. The government ignores these optimality rules in the budget sector.

[1] In the remainder of this study, the term government is used in stead of department. While, as already mentioned, this study is restricted to one sector of the economy, this can be done without problems.

3.3. Optimal Strategy

In this section we specify the utility function of the government. This specification is based on the theoretical remarks, mentioned in section 2, and the observations of section 3.2. Based on this observed behaviour, the theory of welfare economics and the familiar utility theory, we can describe a sector bounded method which guarantees the most optimal government spending.

In stead of the utility function of section 3.2., we assume an utility function with a positive and a negative part to ensure that "marginal cost" and "marginal profits" are weight against another. The positive part, or U^+, is determined by the valuation of the output of the sector, whereas the negative part, or U^-, is described by the budget which is necessary to produce the output. Figure 2 gives the relations between the relevant variables as well as the corresponding equilibrium values. The relations between different variables will be described for each quadrant.

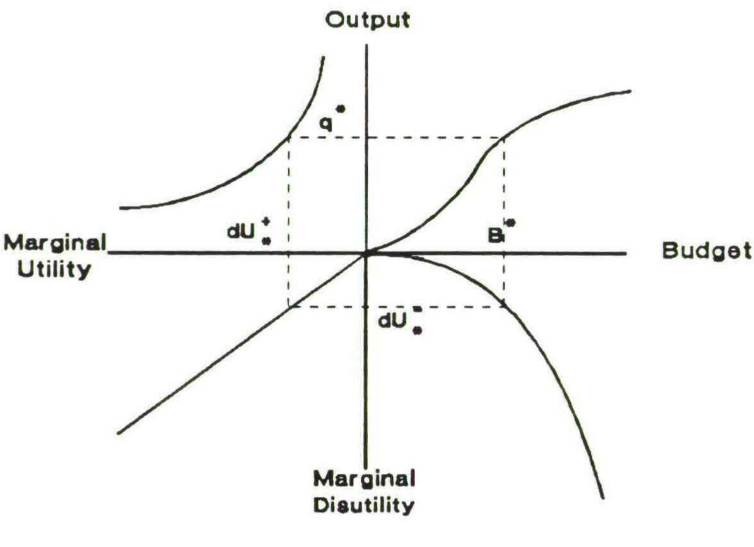

Figure 2: Equilibrium in the budget sector

First quadrant (top right)

This quadrant describes the relation between the size of the budget and the produced output by the non-profit organization. This relation is not equal to the way in which the government allocates the budget to the non-profit organization. Different kinds of inefficiencies are responsible for the difference between these two concepts. Even if the government has perfect foresight, the non-profit organization has the power to create some "slack" which can be used for own objectives. Because of the opportunity costs of the government[2], the non-profit organization is able to produce above the minimum necessary costs. If we define "efficiency" as the minimum necessary costs of production, then it is clear that delegation of the production to the non-profit organization causes inefficiency, even if the government has perfect foresight. In a later section, we shall prove that the structure of the budget is responsible for the level of this inefficiency.

Second quadrant (top left)

The second quadrant specifies the positive part of the utility funtion (U^+). This part is determined by the governments valuation of the output. This utility function is specified to be concave and increasing in its argument. Given this utilitty function, we can straightforward derive the marginal utility function (dU^+), which is shown in the second quadrant of figure 2.

Third quadrant (down left)

This quadrant simply specifies the optimality condition. The equilibrium situation will be reached only if the marginal utility of output (second quadrant) and the marginal disutility of the budget (fourth quadrant) are equal. This condition is represented by the 45°-line.

Fourth quadrant (down right)

The production of output by the non-profit organization is only possible if the government gives the non-profit organization a budget. This budget is formed by the tax payments of the citizens, which cause a disutility to the citizens and therefore to the government[3]. Based on the Engel Curve, which assumes a positive concave relation between consumption and income, and the assumption that

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[2] The opportunity costs are the costs of production by the government itself.

[3] We assume that:

(a) The total tax payments are equal to the allocated budget.

(b) The utility function of the government represents perfectly the preferences of the citizens.

higher tax payments imply less private consumption, the relation between the disutility (U^-) and the tax payment is assumed to be convex and increasing in its argument. Higher tax payments cause a higher disutility, and this relation is assumed to be progressive. Given these relations, it is easy to derive the marginal disutility function (dU^-) drawn in the fourth quadrant.

Equilibrium

The unique equilibrium in figure 2 is given by the quantities corresponding to the corners of the dotted rectangle. Only at these points and in this combination, the equilibrium is reached. This model guarantees that the government can simultaneously determine the optimal volume of both output and budget.

4. Economic Models of Bureaucracy

Market imperfections often result in an intervention by the government. If the government contracts out the production, she usually does this within the budget-sector. But Wolf (1988) shows that there are also "non-market failures". One of the main causes of these non-market failures is the discrepancy between the objective(s) of the government itself, and the objective(s) of the management[4] of the non-profit organization. Even if it is possible to determine perfectly the optimal output and budget of a sector, this discrepancy causes imperfections. As a consequence of the own objectives of the management of the non-profit organization, there is a bandwidth in which output and budget move.

4.1. Modelling Bureaucrats Behaviour

Models concerning the behaviour of those who manage public agencies, and in our case more specifically non-profit organizations, have been developed by many economists. A lot of economic models of bureaucracy that provide an alternative to the traditional profit maximization models used the utility maximization hypothesis. The best-known contributions in this field are the utility maximization models of Williamson (1964) and Niskanen (1971). This last model has been modified by Migue and Belanger (1971). In this section we will discuss these three

[4] In this paper managers and bureaucrats are synonyms.

models in order to obtain a specific utility function of the bureaucrats of the non-profit organization.

The Niskanen Model

Niskanen assumes that bureaucrats will maximize the budget of their organization because all arguments of their utility function are an increasing function of this budget volume. He says:

> "Among the several variables that may enter the bureaucrat's utility function are the following: salary, perquisites of the office, public regulation, power, partronage. output of the bureau, ease of making changes, and ease of managing the bureau. All of these variables except the last two, I contend, are a positive monotonic function of the total budget of the bureau" (Niskanen, 1971, p. 38).

Because the bureaucrats are not confronted with the marginal costs of budget growth, output will be produced until the "marginal profits" are zero. Consequently, the non-profit organization will produce an output level which is beyond the social optimum. Niskanen further assumes that the process will be efficient, that is production at minimum costs:

> "... cost-output production ..... represents the minimum total payment to factors necessary to produce a given output, given the factor prices and available production processes; the cost-output function represents the relation among these points" (Niskanen, 1971, p. 31-32).

To summarize, Niskanen assumes that output will be produced at minimum costs and that the utility function of the bureaucrats results in the ambition towards the highest possible budget which, as we shall see by Mique & Belanger, is equivalent to output maximization. So, the utility maximizing problem of the bureaucrat of the non-profit organization can be represented as follow:

$$\text{Max } V_n = \text{Max } V_n(B) = \text{Max } V_n(q) \tag{3}$$

where

V_n = Utility of the bureaucrat in Niskanen's model

B = Budget of the non-profit organization

q = output of the non-profit organization

The Williamson Model

Firstly, Williamson assumes that both managers of the neoclassical firm and the bureaucrats have an "expense preference" which results in costs of production that are much higher then the minimum costs. As a result of the "non-distribution constraint" of the non-profit organization, the bureaucrats are not able to pay themselves the difference between the minimum costs and the revenues. Therefore, the managers will indirectly profit by producing the output above minimum costs. The difference between the budget and the minimum costs will be used for their own benefit. Williamson assumes that "expenses for the staff function" is the most important manner to maximize the utility function of the bureaucrats, because of the positive relation of staff with elements like salary, status, power and security. In his model the staff expenses are called ***"bureaucratic waste"***.

Secondly, he assumes that the managers of a profit organization have the ambition to reach a level of profit above the required minimal level. The utility of the managers is positively related with the "proud" derived from the excess profit. Translated to the non-profit organization with its non-distribution constraint, it seems reasonable to replace the "profit-ambition" by the aim to produce as much output as possible.

To summarize, the utility function of the bureaucrat in the Williamson model depends not only on "staff expenses" but also on "output". So, the utility maximizing problem of the bureaucrat of the non-profit organization is given by:

$$\text{Max } V_w = \text{Max } V(st,q) \qquad (4)$$

where

V_w = Utility of the bureaucrat in Williamson's Model

St = Staff expenses

q = output of the non-profit organization

The Mique-Belanger Model

The Niskanen model contains an inconsistency which was first noted by Mique & Belanger. First of all, in situations where the budget-function and the cost-functions intersect before the budget-function reaches its maximum, the authors prove:

> " ... In Niskanen's model, budget maximization is equivalent to output maximization with the bureau's budget constraint ... " (Mique & Belanger, 1974, p. 29).

Next, they prove that budget or output maximization will be reached only if the production of the non-profit organization is efficient. So if the bureaucrats are to maximize the budget, only real necessary expenses can be made. This gives the strange situation that there may be no slack in the organization in order to achieve the ultimate goal, i.e. that there is money for elements like salary, status, power. Or, to put it in another way, the bureaucrats maximize their budget to spend some money on the mentioned elements, but, at the same time, they only reach this maximum if they don't spend any money on these elements. This inconsistency is confirmed by Niskanen in an article at 1975. Mique & Belanger concluded that output or budget is not the only argument in the utility function of the bureaucrats.

In the Mique-Belanger model, the utility function contains besides output also slack as a argument. This slack is equal to the "bureaucratic waste" of Williamson's model, but in contrast with Williamson, these authors do not specify this element. They only define slack as the difference between the budget and the minimum necessary costs of production. So, the utility maximizing problem of the bureaucrat of the non-profit organization is now given by:

$$\text{Max } V_{mb} = \text{Max } V_{mb}(S,q) \tag{5}$$

where

V_{mb} = Utility of the bureaucrat of Mique-Belanger's Model

S = Slack (Budget - Minimum Costs)

q = output of the non-profit organization

4.2. Conclusion

Niskanen specificies the utility function of the bureaucrat to depend only on budget or output, but both Williamson and Mique-Belanger make it reasonable to introduce a second argument (bureaucratic waste) in this utility function. While

Williamson models this bureaucratic waste by the preference for larger than required expenses for the staff function, the Mique-Belanger model is more general where it uses the term "slack". Given the inconsistency of Niskanen's model and the more restrictive specification of Williamson, we choose the Mique-Belanger model as most suitable for defining the utility function of the management of the non-profit organization (V):

$$\text{Max } V = \text{Max } V(S,q) \tag{6}$$

An important shortcoming at all these models is the budget function. Each model specifies a single function for the budget, whereas other specifications are not studied. Therefore, it will be interesting to study the effects on the behaviour of the managers of the non-profit organization, caused by a change in the structure of the budget. If the reactions of these managers are different under several types of budget constraints, it is useful for the government to determine which structure will optimize its own utility function. The next section studies the relation government vs. non-profit organization in greater detail.

5. Agency-theory

5.1. Introduction

A main stream of literature within the economic theory of the organization, is formed by the ***agency-theory***. This theory studies the contractual relation between two parties, the principal and the agent. A characteristic feature of this relation is the delegation of authority to the agent, whose actions will influence the utility of the principal. If both parties are utility maximizers, it is reasonable to suppose the agent will not always act in the best interest of the principal. In this agency-paradigm, information plays an important role. When the principal has imperfect information about the "state of nature", the agent has the posibility to act in his own interest, which can be suboptimal for the principal.
The agency-theory assumes that the result of the actions of the agent depends on the agent's effort and of the "state of nature". The most important instrument for the principal to guide the agent is the contractual relation between two parties. Sharing the risk between principal and agent depends on their attitudes towards

risk and on the information that is available to the principal. The principal must provide incentives for the agent to make choices which will maximize the principal's utility.

5.2. The role of budgeting

Agency-theory stresses the role of the contract in the principal-agent-relation. The contract determines the "scope of action" for the agent, which together with the "state of nature" influences the utility of the principal. The contract between the government (principal) and the bureaucrats of the non-profit organization (agents) is formed by the ***structure of the budget***. This underlines the important role of budgeting in the relation government vs. non-profit organization.
We concluded that the utility function of the bureaucrats, based on the three models of section 4, has two arguments, output (q) and slack (S), which can't directly be determined by the government. The second argument (S) is defined as the difference between the budget (B) and the minimal costs (C), both depending on the output (q). The minimum costs (C) must be seen as a normative variable which is exogenous to the government. Therefore, the slack (S) is the result of the endogenous budget (B) and the exogenous costs (C). The budget can be influenced by the government by choosing the structure of the budget.

The government can choose different forms of budgeting the non-profit organization. The budget structure must be choosen such, that on the one hand the non-profit organization will find it worthwhile to produce the output, but that on the other hand overproduction is avoided. In our model, we specify a budget function which is formed by a fixed and a variable part. As usually, the first part is independent of the level of production of the non-profit organization, the output (q), whereas the second part is modelled as a lineair relation of production. Let us define the parameter F as the fixed lump-sum fee and the parameter K as a constant fee for each unit of output, then the budget function to the non-profit organization, B(q), can be expressed as:

$$B(q) = F + K \cdot q \tag{7}$$

This budget function describes a budget range from totally fixed to totally variable.

If the parameter K is zero, the budget is called a ***lump-sum inputbudget***, whereas a ***outputbudget*** is given by a budget structure with F equal to zero. If both parameters are positive ($F > 0$, $K > 0$), the combination is called a ***mixed budget***.
These different kinds of budget structures represent the dilemma of the government by weighting out stimulation of the performance against the risk of overproduction (which implies an excessive growth of the budget). A lump-sum inputbudget guarantees the government a fixed budget volume (no risk), but it doesn't stimulate the non-profit organization to produce at all, because extra production has no budget effect. On the other hand, outputbudgeting stimulates the production of the non-profit organization enormously, but the government looses control over its budget, because each unit must be financed. Both aspects are relevant for the mixed combinations in varying degrees. As shown in section 3.3, the utility function of the government (U) has both output and budget as its arguments. The goal function of the government is given by:

$$\text{Max } U = \text{Max } U(q,B) \tag{8}$$

subject to

$$\text{Max } V = \text{Max } V(q,S)$$
$$B(q) = F + K.q$$

The government must choose that kind of combination of F and K that maximizes their own utility function. The optimal combination is given by $[F^*, K^*]$.

Conclusion: The agency-theory stresses the role of the contract in a principal-agent relation. To guide the bureaucrats of the non-profit organization, the government can use the structure of the budget in different ways. An outputbudget is very stimulating to the production of the non-profit organization but it implies an uncontrolled budget volume for the government. A lump-sum inputbudget has just the opposite consequences.

6. Budgeting with perfect foresight

6.1. Introduction

In this section we study the effects of the structure of budgeting by the government on the behaviour of the non-profit organization. First of all, we study this behaviour in the situation the government has perfect foresight. In that case, the government exactly knows both the utility function of the bureaucrats of the non-profit organization (V) and the minimum cost function (C) of this organization. In the case of imperfect information, the government is confronted with uncertainty with respect to these functions. Both situations, perfect and imperfect foresight by the government, will be studied using two forms of budgeting, the lump-sum inputbudget and the outputbudget, which characterize the both extremes of the budget function. Firstly, we will study the process whereby the government uses a lump-sum inputbudget, followed by an enunciation of the behaviour of the government in the case of outputbudgeting.

6.2. Lump-sum inputbudgeting

The budget equation in the case of an inputbudget, B^i, is given by

$$B^i = F \tag{9}$$

The government chooses a level of F, which yields the maximum utility and depends on the behaviour of the bureaucrats at the non-profit organization. Therefore, we study this behaviour at some levels of F. The cost function C(q) represents the minimum costs for the non-profit organization which are exogenous to the government. Figure 3 shows the cost function C(q) and three different levels of the inputbudget. These budgets, once determined, are independent of the output q and therefore represented by a straight, horizontal line.

Next, it it possible to construct the slack as a function of q in the situation of a lump-sum inputbudget. The slack (S^i) was defined as the difference between the budget (F) and the cost C(q). Given the specification of the inputbudget, this relation is given by:

$$S^i(q) = F - C(q) \quad ====> \quad F = S^i(q) + C(q) \tag{10}$$

so

$$q = q(F) \tag{11}$$

In this section, we will illustrate this influence of the budget level on the output of

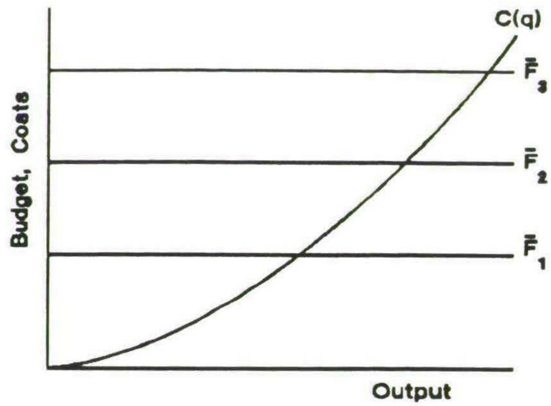

Figure 3: Different levels of an inputbudget

the non-profit organization as shown in equation (11). In figure 3, three different levels of F are drawn, which result in three curves of $S^i(q)$ which are shown in figure 4 (S1, S2 and S3).

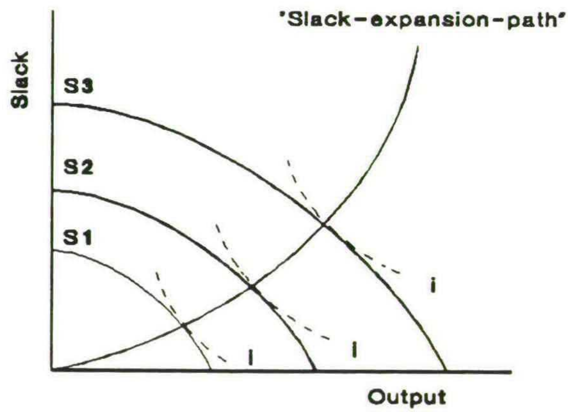

Figure 4: The Slack-Expansion-Path (SEP) in the case of inputbudgeting

Next, it is possible to construct some indifference curves of the bureaucrats in the non-profit organization. In section 4, have already concluded that the utility function of these bureaucrats has two arguments, output and slack. Given the axes of figure 4, with output on the horizontal and slack on the vertical axis, it it possible to add some of these indifference curves to the figure. As a consequence of the characteristics of concavity of the utility function, these indifference curves are convex to the origin[5]. Figure 4 shows the slackcurves $S^i(q)$ that are concave to the orgin. So, each of these slackcurves must have a point of tangency with an indifference curve. By connecting these points of tangency, we get a path which represents the set of optimal combinations [q,S] for the non-profit organization. A possible form of this path is given in figure 4, which will be called the "Slack-expansion-path" [SEP]. Given the cost function of the non-profit organization and the utility function of the bureaucrats, the SEP shows the optimal combinations [q,S] to the bureaucrats at each level of F. This expansion path is given by:

$$\begin{aligned} SEP^i &= SEP^i((q^i,S[q^i])) \\ &= SEP^i(q^i) \end{aligned} \tag{12}$$

So, the SEP^i is a funtion of q^i, which is determined by the level of F. Next, it is possible to determine the necessary volume of the budget for each level of output. This budget volume is equal to the sum of the realized slack and the minimum cost of producing a certain level of output. The relation between the output and the corresponding budget will be called the "budget-expansion-path" (BEP). In equation forms, the BEP for inputbudgeting is equal to

$$\begin{aligned} BEP^i &= C(q^i) + SEP(q^i) \\ &= h(q^i) \end{aligned} \tag{13}$$

Figure 5 shows an example of the cost function, the SEP and the BEP, which illustrates that even with perfect foresight, the government must pay the non-profit organization a budget that is higher than the minimum cost. The difference between these two curves, represented by the $SEP^i(q^i)$, is a good measure for the level of inefficiency.

In order to define an expression for the relation as given in the first quadrant of figure 2, it is necessary to determine the ***inverse relation*** of equation (10).

$$q^i = h^{-1}(BEP^i) \tag{14}$$

[5] See Deaton and Muellbauer, ***Economics and Consumer Behaviour***, p. 30.

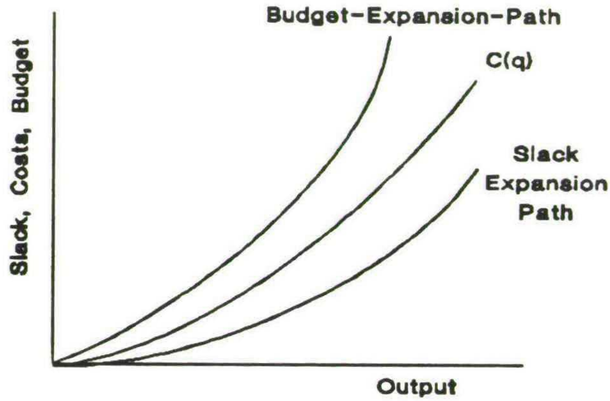

Figure 5: The BEP as sum of the SEP and the cost function

This BEP represents the consequent budget (F) necessary to produce some level of output. Therefore, equation (14) can be written as

$$q^i = q(F) \tag{15}$$

which is equal to equation (11). This relation, which shows the output (q) as a function of the budget-volume, is called the "output-expansion-path" (OEP) and represents the realized output by the non-profit organization for each level of budget. As will be known, this relation depends on the cost function of the non-profit organization, the utility function of the bureaucrats of the non-profit organization and the budget structure, which is determined by the government.

The objective function of the government, as shown by equation (8), is now specified by:

$$\max_F U = \max U(q^i,F) \tag{16}$$

subject to

$$\begin{aligned} \max V &= \max V(q,S) \\ B &= F \\ q^i &= q(F) \end{aligned}$$

Because the government knows these relations, it chooses that level of F that maximize its own goal: F^*.

6.3. Outputbudgeting

Instead of the fixed sum F, the budget equation in the case of outputbudgeting is given by:

$$B^{o}(q) = K.q \tag{17}$$

The number of units produced by the non-profit organization is financed by a constant fee (K). The government chooses the level of K which yields the maximum utility. Figure 6 shows some budgetlines in relation with the cost function C(q). These budgetlines are represented by straight lines by which the level of K determines the tangency of the budgetlines.

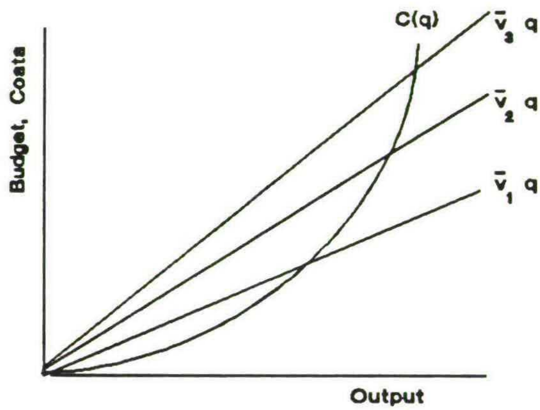

Figure 6: Different levels of an ouputbudget

Once the budget function is determined, the framework used in the inputbudgeting case, can again be applied. First of all, it is possible to determine the slack at each budget level. The curves of the slack function yield, together with the isoquants of the utility function of the bureaucrats, the SEP. Figure 7 illustrates this graphically.

Next, we can construct, in the same way as the inputbudgeting case, the BEP as sum of the cost function and the SEP. Analogous to the expansion-path in the case

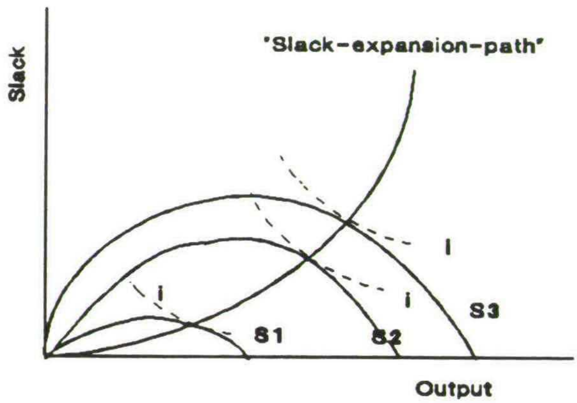

Figure 7: The slack-expansion-path in the case of outputbudgeting

inputbudgeting, the BEP° can be written as a function of K which results in an output-expansion-path as a function of the level of K:

$$q^{\circ} = q(K) \tag{18}$$

The objective of the government is now given by

$$\max_{K} U = \text{Max } U(q^{\circ},K) \tag{19}$$

subject to

$$\begin{aligned} \text{Max } V &= \text{Max } V(q,S) \\ B(q) &= K.q^{\circ} \\ q^{\circ} &= q(K) \end{aligned}$$

The government chooses that level of K(q) that maximize its own goal: K^{*}.

6.4. Conclusion

In section 6, the relation corresponding to the "function" given in the first quadrant of figure 2 has been specified for both input- and outputbudgeting. From the equations (15) and (18), we can conclude that the behaviour of the bureaucrats of the non-profit organization is influenced by the choice of the budget function. The OEP's of the mixed budget structures can be determined in the same way. The government will choose the combination $[F^*, K^*]$ that optimize its own utility, which is equivalent to the choice of budget structure that will yield the highest OEP.

In the case of perfect foresight, the government simultaneously will determine the optimal level of the output and of the budget volume. Therefore, the OEP's corresponding to the different budget structures can be compared at the same budget level. At every budget volume, the government can determine the level of output for each budget structure. The structure which will yield the government the highest output will be optimal for the government, and thus be chosen.

7. Imperfect foresight

7.1. Introduction

It seems more reasonable to assume that the government doesn't have perfect information at the cost function of the non-profit organization and the utility function of the bureaucrats. The government knows it can over- or underestimate the position of the OEP's, so it is confronted with a bandwidth of OEP's in stead of some clear defined paths. In this section we will study the consequences of imperfect foresight for both input and outputbudgeting.

7.2. Lump-sum inputbudgeting

Figure 8 shows the situation of imperfect foresight for the inputbudgeting case. In stead of one OEP, there are three paths which represent the range of possibilities. First of all, the government estimates the OEP which in combination with the marginal utility function of output (dU^+, top left), the marginal disutility function of the budget (dU^-, down right) and the condition of optimality ($dU^+ = dU^-$, down left), yields us the optimal level of output (q^*) and budget (B^*). The real budgetline, B_i, is therefore equal to the estimated optimal budget B^*.

Because the government only has imperfect information, it is possible that the realized expansion-path is positioned above the estimated path. In figure 8, this situation is represented by ***path A***. In that case, the government receives more output at the same budget than she expected to receive, which results in a higher utility for the government. But if we relate the output that results at path A, q_A,

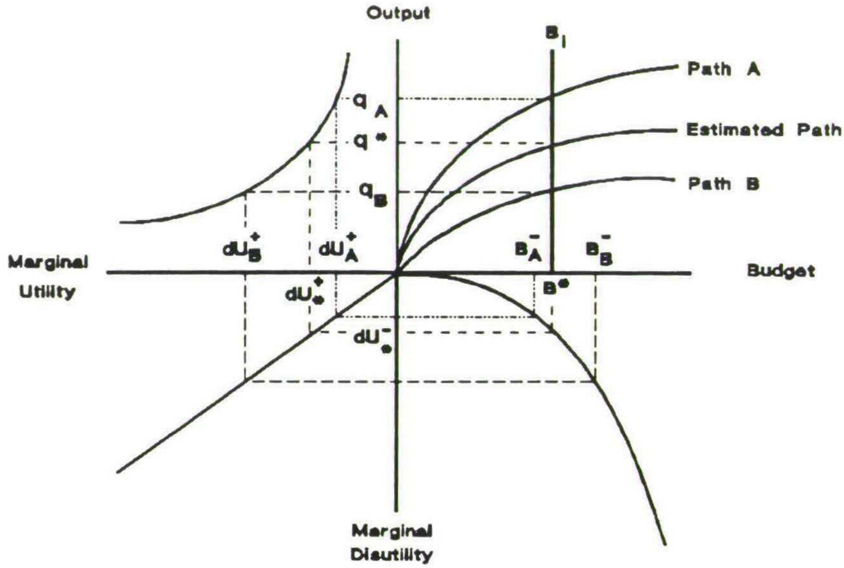

Figure 8: Inputbudgeting in the case of imperfect foresight to the

corresponding budget B_A that would be optimal at this output level, determined by the optimality condition in the third quadrant, it it clear that this situation is not optimal. The budget B_A is not equal to the realized budget B_i, implying that marginal utility and marginal disutility are not equal. To optimize its utility, the government should lower its budget somewhere between B_A en B^*. Although, the utility of the government is now higher then at the estimated situation, it doesn't represent the optimal situation.
Just the opposite holds for the lower ***path B***. The lower output q_B results in the discrepancy between the actual budget B^* and the corresponding higher budget B_B The government should expand their budget to receive the optimal situation but this is prevented by the lump-sum inputbudget.

Conclusion: If the OEP is higher then expected, the government receives a higher level of output at the same budget level. Therefore, the utility of the government increases, but is suboptimal because of the discrepancy between the marginal utility of output and the marginal disutility of the budget. To optimize the utility, the government would ex post like to lower its budget, but this is prevented by the system of an ex ante fixed lump-sum-budgeting. For a lower OEP the conclusions are just reversed.

7.3. Outputbudgeting

In the case of outputbudgeting, the government chooses the K that optimizes its utility level. This fee is chosen such that the budgetline and the estimated OEP cut each other in the optimal combination of q and B, which are represented by q^* and B^* as shown in figure 9.

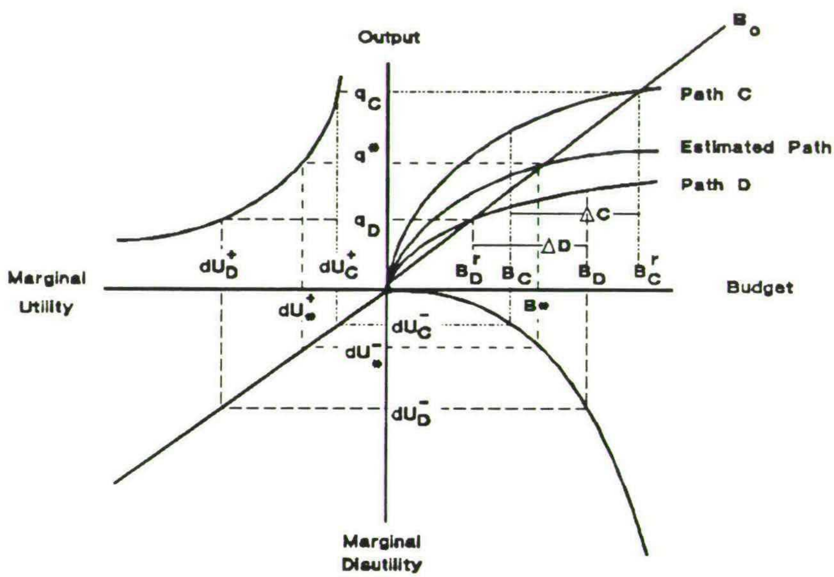

Figure 9: Outputbudgeting in the case of imperfect foresight

We begin by studying the consequences of the situation in which the real path lies above the estimated one. In contrast with the case of inputbudgeting, not only the level of output is affected, but also the budget volume. The higher expansion-path, ***path C*** in figure 9, results in the outputlevel q_C and the real budget volume B_C^R. The outputlevel q_C, which is higher then the (estimated) optimal output q^*, corresponds to a marginal utility of output of dU_C^+. Given the optimality condition, the optimum would be reached if the marginal disutility of budget would equal dU_C^-, which would result in a budget volume of B_C. Because B_C^R and

B_C differ, represented by triangle C, the realized budget B_C^R in the situation of path C is suboptimal. In this situation, both the positive and the negative part of the utility function increases, so it is not clear whether the utility of the government increases or decreases in contrast with the estimated situation. But, it is clear that to optimize its utility, the government should decrease the budget somewhere between B_C and B_C^R by lowering the fee (K^*).

The results of a lower expansion-path, ***path D***, are just opposite to the ones corresponding to path C. The realized budget is given by B_D^R, while the budget which is optimal to the output q_D is given by B_D. Both the positive and the negative part of the utility function are decreased, whereas the government must increase its budget to optimize its utility.

7.4. Conclusion

Imperfect information with respect to both the cost function of the non-profit organization and the utility function of the bureaucrats, results in a bandwidth of OEP's in stead of one clear defined path. Table 1 shows the consequences to both the positive and the negative part of the utility function, the consequences to the total utility and the preference of the government with respect to the budget.

	Mutations			
	U+	U-	U	dB
Higher OEP, Inputmodel	+	0	+	-
Higher OEP, Outputmodel	+	+	?	-
Lower OEP, Inputmodel	-	0	-	+
Lower OEP, Outputmodel	-	-	?	+

Table 1: Consequences of the higher and lower OEP's in the case of imperfect information

The comparison of the different expansion-paths is more difficult then in the case of perfect foresight, where the government compared these paths at the same budget level. When the government has imperfect information, this is no longer possible, so that it is unclear which budget structure maximimizes the utility of the government. The government is confronted with uncertainty to both output and budget.

8. The Mathematical Model

8.1. Introduction

In the last two sections, we discussed the role of budgeting in the relation government vs. non-profit organization. Until now, the analysis is mainly descriptive. In this section, we present a model which further analyses the described theory, in order to conclude which budget structure will be optimal for the government. Because of the extensiveness of the model[6], only the main features are presented.

8.2. Modeling the situation of perfect foresight

The utility function of the government (U) can be given by:

$$\operatorname*{Max}_{B} U = \operatorname{Max}\,(U^{+} - U^{-}) \tag{20}$$

subject to

$$V = \operatorname{Max} V(q,s) \qquad S > 0,\ q \geq 0$$

where

$$U^{+} = \tau \ln(q) \qquad \text{with } \tau > 0 \tag{21}$$

$$U^{-} = \phi\, e^{\mu B(q)} \qquad \text{with } \phi, \mu > 0 \tag{22}$$

As shown earlier, the utility function is represented by the difference of the positive and the negative part. The argument of the positive part of the utility function is output. As related in section 3.2., this part of the utility function is specified to be concave and increasing in its argument. The negative part of the utility function depends on the disutility of the tax payments. The relation between the disutility and the tax payments is assumed to be convex and increasing in its

[6] The mathematical model will be the main part of my dissertation, "Budgeting the non-profit organizations: An agency-theoretic approach" (in Dutch), forthcoming 1991.

argument.

In section 6.4, we have concluded that the government can perfectly determine the level of output and the budget volume simultaneously. Therefore, the government can compare each budget structure given a certain budget volume[7]. We introduce the parameter δ which determines the relative proportion of the fixed part of the budget. The budget function is specified by:

$$B(q) = \delta F + (1-\delta)Kq \qquad \text{with } 0 \leq \delta \leq 1 \qquad (23)$$

The relation between output and budget, q = q(B), as given in the first quadrant of figure 2, can't be derived until the utility function of the bureaucrats and the cost function of the non-profit organization are specified. The economic models of bureaucracy assume that the utility function of the bureaucrats (V) depends on both output and slack. We assume that the utility is concave and increasing in both output and slack. The utility function is given by:

$$V(S,q) = x\ln(S[q]) + y\ln(q) \qquad \text{with } x \geq 0,\ y \geq 0 \qquad (24)$$

The utility function of the bureacrats of the non-profit organization is defined as the sum of both the arguments. To determine the relative influence of both arguments, we define α as the quotient of $[x/(x+y)]$. So, it is possible to write the utility function of the bureaucrats as:

$$\begin{aligned} \text{Max } V &= \text{Max } V(q,S) \\ &= \text{Max } \{\alpha \ln(S[q]) + (1-\alpha)\ln(q)\} \end{aligned} \qquad (25)$$

Next, we must define the cost function of the non-profit organization. The cost function is assumed to be convex, containing both a fixed part and a variable part which depends on the outputvolume. The cost function is given by:

$$C(q) = a_0 + a_1 q + a_2 q^2 \qquad \text{with } a_0, a_1, a_2 > 0 \qquad (26)$$

[7] At each possible budget volume.

From section 6.2, we know that slack (S[q]) is defined as the difference between the budget (B[q]) and the cost (C[q]) at each outputlevel. Given these equations, we can specify the utility function of the bureaucrats by:

$$V = \alpha \ln[\delta F+(1-\delta)Kq-a_0 -a_1 q+a_2 q2] + (1-\alpha).\ln(q) \tag{27}$$

In equation (27), the bureaucrats can only choose the level of output (q), because the other parameters (F,K, α, a_0, a_1 and a_2) are exogenous to the bureaucrats. The utility function (V) is maximized by the value of q for which the first-order condition is equal to zero.

$$\frac{dV}{dq} - \frac{\alpha[(1-\delta)K-a_1 -2a_2q]}{[\delta F^{*}+(1-\delta)Kq-a_0 -a_1q+a_2q^2]} + \frac{(1-\alpha)}{q} = 0 \tag{28}$$

which result in the following specification of the OEP:

$$q = \frac{\{(1-\delta)K-a_1\} + \sqrt{\{[1-\delta)K-a_1]^2+4a_2(\delta F-a_0)(1-\alpha^2)}}{2a_2(1+\alpha)} \tag{29}$$

Equation (29) represents the mathematical expression of the OEP of the first quadrant of figure 2. This equation is the result of the utility maximizing behaviour of the bureaucrats, which can be used by the government to determine the optimal combination [F,K].

8.3. Optimal Choice

As the government knows the expression of the OEP, she can use this in order to optimize her own objective. The utility function of the government is specified by

$$\underset{F,K}{\text{Max}}\, U = \text{Max}\, [\tau\ln(q) - \phi\, e^{\mu.\{\delta F^{*} + (1-\delta)Kq\}}] \tag{30}$$

In the case of perfect foresight, the government can determine exactly the optimal

level of the output and of the budget volume. Therefore, it is possible to compare the utility of the government for each budget structure ***at the same budget volume,*** which implies that the second part of equation (30) is equal for each combination [F,K]. Therefore, the utility of the government is maximized by the budget structure which yields the highest output. The expression of the OEP is given at equation (29). The optimal budget structure is defined by the specification of the parameter s. Therefore, it is necessary to determine the first-order condition of the OEP with respect to s (see Appendix A). Because ultimately, the parameter s does not appear in the first-order condition, the restriction on s implies a boundary solution. Further analysis (see appendix A) makes clear that, ceteris paribus, the output is maximized at a value of $s = 0$ which is equal to an outputbudget.
Conclusion: Given the model specification, outputbudgeting maximizes the utility of the government in the situation of perfect information.

9. Imperfect foresight: a simulation model

9.1. Introduction

Usually, the government contracts out the production to the non-profit organization, whithout having perfect information about the utility function of the bureaucrats and the cost function of the non-profit organization. In section 7, we demonstrated that this imperfect foresight results in a bandwidth of the OEPs instead of one well-defined path. This implies that it is not clear what the exact effects are for the utility function of the government and in what proportion the different budget systems bear to one another. In this section, we will, using the model of section 8, compare the models of budgeting in the case of imperfect information.

9.2. Expected Utility Theory

In the case of imperfect information, the government is confronted with decision making under uncertainty. The well-known theory which is often used in this kind of situation, is the "expected utility theory". Halter and Dean say:

> "The theory and rationale for using the maximum expected value of utility as a general criterion of choice in decision making under uncertainty", (Halter and Dean, 1972, p. 32)

The expected utility seems to be a good measure of the behaviour of the government in decision making under uncertainty, because it incorporates not only the expected value of output but also the variability of this output. Therefore, the risk attitude of the government is correlated with the shape of the utility function. Varian (1984) and Halter and Dean (1971) prove that concavity of the expected utility function is equivalent to risk aversion. Formally, it can't be proved that the government function in our model is concave[8]. But, given the shape of both the positive and the negative part (as a function of q) of the utility function and the fact that they intersect[9], it follows that the utility function is concave, which is equivalent with a ***risk avers*** government.

Next, we should determine the expected value of the utility function of the government. Now, the goverment is confronted with the stochastic output q, which is attended with an error term ϵ. The expected value of the utility function can only be assesed if we specify a probability distribution of the error term. But, even if we take a simple probability function like the uniform distribution, it is impossible to get an expression of the budget structure which yields some clear results. Therefore, a possible way to gain an insight into decision making under uncertainty is a model which simulates this process.

9.3. Simulation

The simulation model is based on the model of section 8 and tries to incorporate the behaviour of the government under uncertainty. Therefore, the parameter of the utility function of the bureaucrats and the parameters of the cost function of the non-profit organization are assumed to be stochastic. We will test the next nul-hypothesis:

> H_0: *The utility function of the government in decision making under uncertainty is always maximized by outputbudgeting.*
>
> H_A: *The utility function of the government in decision making under uncertainty is not always maximized by outputbudgeting.*

---

[8] A function with two arguments, F^* and K^*, satisfies the definition of concavity, only if the matrix of second derivatives is non-negative definite. A 2x2-matrix satisfies this condition if the diagonal elements are negative and the product of these elements minus the product of the non-diagonal elements is positive.

[9] If both curves don't intersect the output level is zero or infinite, which is assumed to be impossible.

Using a simulation model has a lot of restrictions with respect to the conclusions. It is, for instance, impossible to conclude that one way of budgeting would *always* be the best. Therefore, we only may conclude that we can't reject the H_0-hypothesis at the studied situation or that we must reject the H_0-hypothesis in favour of the H_A-hypothesis.

The results of the simulation process, as given in appendix C, are clear. Firstly, the expected value of the utility of the government decreases for every combination [F,K] if the uncertainty increases. Secondly, the results show that outputbudgeting will not always be optimal to the government. The expected value of the utility using outputbudgeting will frequently be lower than the value obtained applying a mixed budget. When the uncertainty increases, the optimal model shifs more and more in the direction of the mixed models with a relative higher fixed part of the budget.
Conclusion: Increasing uncertainty results in a shift towards a budget with a bigger fixed component[10].

10. Summary and Conclusions

This paper studied the relation between the government and the non-profit organization from an agency theoretic perspective. This theory stresses the role of the budget structure in the relation between these two parties. The main goal was to study how to maximize the social welfare function of the government, when the production was contracted out to the non-profit organization.
We started by studying the theories of "Public Finance" and "Welfare Economics", in order to determine an utility function of the government. The theories of Pigou, Pareto and Bergson were enuciated. These models resulted in an utility function of the government in which both the utility of output and the disutility of the budget are incorporated.
Secondly, contracting out the production resulted in sharing the risk between principal and agent. The results of this process depend on the risk attitude of both

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[10] Only at a very small level of uncertainty, outputbudgeting may be optimal. This is not suprising, because at such a uncertainty level the model can hardly be distinguished from the model under certainty.

parties and of the kind of information the principal has. The principal must provide incentives for the agent to make choices in a way that will maximize the principals utility. To determine the utility function of the agent (= bureaucrat), the economic models of bureaucray of Niskanen, Williamson and Mique & Belanger were studied, which implied an utility function of the bureaucrats which depends on both output and slack.

The budget structure was defined as a function which ranges of totally variable (outputbudgeting) to totally fixed (lump-sum inputbudgeting) with mixed models in between. The results of different forms of budgeting to the maximization process of the government were described, both in the case of perfect and imperfect foresight to the government.

Finally, we presented the model which represents these theories and tried to optimize the utility function of the government. The results of this model are clear: the utility function of the government in decision making under perfect foresight is always maximized by outputbudgeting, whereas the simulation model, based on the maximization of the expected value of utility as a criterion of decision making under uncertainty, makes clear that the government can better choose a mixed model in the case of imperfect information. Greater uncertainty will result in a higher proportion of the fixed part in the total budget.

Appendix A

The output (q) is maximized by the value of δ for which the first-order condition is equal to zero. This gives:

$$\frac{dq}{d\delta} = \frac{-K + 0{,}5(R)^{-0,5}\{[2(1-\delta)K-a_1)-K + 4.a_2.F(1-\alpha^2)}{2a_2(1+\alpha\}} = 0 \qquad (A.1)$$

where

$$R = \{[1-\delta)K-a_1]^2 + 4a_2(\delta F-a_0)(1-\alpha^2)$$

Equation (A.1) is equal to zero only if:

$$\frac{2a_2F(1-\alpha^2) - (1-\delta)K-a_1)K}{\sqrt{(R)}} = K \qquad (A.2)$$

Straightforward calculus yields:

$$K^2\{(1-\delta)K-a_1\}^2 - 4K^2a_2(1+\alpha)\{(\alpha-1)\delta F+(1-\alpha)a_0)$$
$$=$$
$$K^2\{(\delta-1)K+a_1\}^2 - 4a_2FK(1-\alpha^2)\{(\delta-1)K+a_1\} + 4a_2F^2(1-\alpha^2)^2 \qquad (A.3)$$

This can be written as:

$$K^2(F-a_0) - F[Ka_1 - Fa_2(1-\alpha^2)] = 0 \qquad (A.4)$$

Because the parameter δ does not appear in equation (A.4), the restriction on δ implies a boundary solution. An example (see appendix B) yields that the output will be maximized at a level of $\delta = 0$, which is equal to outputbudgeting. At the same budget volume, this budgeting structure yields the highest utility to the government. In appendix B (table B.2., columm U[perfect]), it can be seen that in the case of perfect information, the utility of the government at a system of outputbudgeting (combination 1) is higher than at each other system.

Appendix B

Values: $\mu(a_0) = 7.500.000$ $\qquad \mu = 1{,}5 \cdot 10^{-7}$
$\mu(a_1) = 1.500$ $\qquad \tau = 1000$
$\mu(a_2) = 8$ $\qquad \phi = 20$
$\mu(\alpha) = 0{,}4$

Variation coefficient of $a_i = \sigma(a_i)/\mu(a_i)$ is the same for all parameters. Table B.1 shows two possible simulations for the government.

Simulat.	Variation coefficient	σ(a0)	σ(a1)	σ(a2)	$\sigma(\alpha)$
1	3,0%	225.000	54	0,24	0,012
2	8,0%	600.000	136	0,64	0,032

Table B.1: Values at two possible simulations

The budget combinations [K,F] are determined given the values of the parameters. Firstly, the government chooses the level of K that optimizes its utility function (with F = 0). This results in a level of K = 17.497 and a utility of 6631,66. Next, the same is done the case of inputbudgeting (K = 0). Finally, two mixed models are determined with resp. F = 2.500.000 and F = 12.500.000, whereafter the corresponding K that optimizes the utility of the government is determined. The resulting utilities are shown in tabel B.2 [U(perfect)]. Secondly, we determine the utility of each combination for simulation 1 and 2.

Comb.	K	F	U(perfect)	Simulat. 1	Simulat. 2
1	17.497	0	6631,66	4553,06	3981,21
2	15.777	2.500.000	6589,20	6572,18	6117,53
3	7.979	12.500.000	6393,57	6393,27	6392,09
4	0	18.672.400	6218,25	6218,11	6217,66

Table B.2: Results of the simulation model

The result show that for simulation 1 the expected utility of the government is maximized at combination 2, whereas for simulation 2 combination 3 is optimal.

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